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ABSTRACT

This publication is an interim edition of a curriculum guide published by the Ministry of Education of British Columbia for use during the 1977-78 school year. This revised guide is to replace the "old" Elementary Science Program first introduced in 1964 (Primary), 1968 (Intermediate and Grade VII), and the alternative Materials Based Program introduced in 1969. The guide includes a rationale for revision, the philosophy of elementary science education, description of the programs (three programs in all), the evaluation procedure, research and reporting skills, and a basic equipment and materials list. (GA)

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# ELEMENTARY SCIENCE

## Teachers Curriculum Interim Guide 1977

CURRICULUM DEVELOPMENT BRANCH
MINISTRY OF EDUCATION
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ELEMENTARY

SCIENCE

INTERIM GUIDE

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- The Elementary Science Review Committee; Sandra Boyle, Sylvia Hoenson, June Irvine, Bob Mukai, Ardele Schooley, Gerald Sieben, Arnold Weid
- Those elementary teachers and university personnel who reacted to the draft versions of the guide, in particular Dr. Larry Yore.
- Teachers who assisted in the selection of material.
- The Ministry of Education Curriculum Consultants to the Committee; Brian Tetlow, Will Dunlop, Sylvia Hoenson.

The Ministry of Education has approved the publication of this interim guide and accepts responsibility for its contents.

## INTERIM EDITIONS

This curriculum guide which outlines the revised Elementary Science Program has been published as an INTERIM EDITION for use during the 1977-78 school year.

During the early part of the 1977-78 school year, the Ministry will welcome comments and suggestions relative to the guide. These reactions will be considered in the preparation of the final curriculum guide, which it is anticipated will be available for the 1978-79 school year.

A second publication related to the revised program will also be available for 1977-78. This publication, Materials Based Units Program, has been developed to support one of the three programs authorized under the revision. This publication will also be in interim form and any reactions from the field will be considered in the preparation of the final draft, which will be available for 1978-79.

Reactions should be directed to the Curriculum Development Branch, Ministry of Education, 835 Humboldt, Victoria.

## RELATIONSHIP TO GOALS OF THE CORE CURRICULUM

Among the goals and learning outcomes included in the Ministry publication What Should Our Children Be Learning - Goals of the Core Curriculum are a number which relate to the area of science, particularly as indicated in Goal G - "To Develop Knowledge of Science As Related to Everyday Life".

This Goal and the related outcomes have been considered in the development of this revised program. However, as the Core Curriculum document will be open to revision on the basis of reactions which are still being received at the time of writing, no attempt has been made to relate this document in a specific way to this interim curriculum guide.

One of the major reasons for producing this curriculum guide as an interim publication for 1977-78 is that such a procedure will permit modifications to be made before the final edition is printed. It is anticipated that the final Elementary Science Curriculum Guide (available for 1978-79) will reflect in a very specific way the goals and learning outcomes for science as they appear in the final Core Curriculum document.

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## I. RATIONALE FOR REVISION

As the result of numerous requests from the field, in 1972 the Ministry established an Elementary Science Review Committee. During the assessment of the existing programs this Committee provided the opportunity for all elementary science teachers in the Province to express their concerns and indicate the direction they felt a revision should take. On the basis of the reactions received and their own deliberations, the Review Committee reported that the materials based program developed in 1969 was a very viable program but that it was not successful in all situations. Among the reasons suggested were differences in philosophy of teachers and schools, differences in the teacher preparation, and differences in available facilities. The Committee recommended the continued authorization of a materials based program but that text books should also be made available. It was felt that some schools and/or teachers might wish to use the books in conjunction with the materials based program, whereas others might wish to use a textbook program as the basis for their teaching of science.

The Revision Committee has developed a new program which permits these various approaches

## II. IMPLEMENTATION

The revised program will be introduced in September 1977. It will replace the 'old' Elementary Science Program first introduced in 1964 (Primary), 1968 (Intermediate and Grade VII), and the alternative Materials Based Program introduced in 1969.

## III. PHILOSOPHY

The philosphy of elementary science education during the past decade has manifested itself in the design and implementation of programs which are primarily process oriented. Investigation and inquiry have been key words in describing these programs. Programs emphasizing the acquisition of factual knowledge were replaced by those with an emphasis on method and process.

Recent programs attempt to reflect the nature of science which may be defined as the process of seeking answers and understandings about the natural world. Equally as important is the knowledge, skills and attitudes that the process produces.

There is a growing assertion by educators that a position of philosophy entrenched at either of these extremes is unacceptable as a basis for elementary science teaching. Teaching strategies focused at the extremes have failed to create for students a learning environment which encourages the pursuit of scientific literacy - knowledge which has survival value, attitudes relevant to the scientific world of the future, and rational critical thought processes. A more balanced approach to science education is needed.

Investigation and problem solving are essential in providing experiences with the processes of science. Expository instruction on the other hand, is one method whereby the content can be transmitted. It has been stated that .... "method is meaningless in the absence of subject matter, stuff to work upon. Subject matter is sterile if not permeated with questions about how we know, and why be bothered to find out."[1]

The processes we assign to "sciencing" are in fact those involved in all learning. They become science processes when they are applied to the understanding of scientific concepts arranged in conceptual schemes. Process, content, order - all are interwoven, interrelated, and indispensable. A program which recognizes that each has a place in elementary science education would seem to be reasonable.

It is possible to identify and define the science processes. Although the extent to which each process is used varies considerably from one activity to another, little doubt exists among science educators that the learning of these processes as approaches to the acquisition of knowledge forms a vital component of any science program.

[1]Morrison, Philip, Tensions of Purpose, ESI Quarterly Report, Educational Development Corporation, Newton, Mass. (1966)

It is the intention here to provide the opportunity for the implementation of a science program which permits and encourages the integration of both process and content. Science instruction today must reflect an awareness of the need for balance; to do so will place the learner in an environment which makes possible the realization of literacy in science.

## IV. GOALS AND LEARNING OUTCOMES

GOAL A — THE ELEMENTARY SCIENCE PROGRAM SHOULD DEVELOP IN STUDENTS, APPROPRIATE SCIENCE ATTITUDES

Learning Outcome

1. During the Elementary Science Program the student should demonstrate attitudes of:

   a. awareness, appreciation and interest for the world and its potential

   b. curiosity - to question and seek answers in the various areas of Science

   c. rationality - the ability to look for natural causes of natural events

   d. critical thinking

      i. to identify central issues

      ii. to recognize underlying assumptions

      iii. to evaluate evidence or authority

         - to recognize stereotypes and cliches
         - to recognize bias and emotional factors in a presentation
         - to distinguish between verifiable and unverifiable data
         - to distinguish between relevant and nonrelevant
         - to distinguish between essential and incidental
         - to recognize the adequacy of data
         - to determine whether facts support a generalization
         - to check consistency

      iv. to draw warranted conclusions

   e. adapt in a changing world

GOAL B THE ELEMENTARY SCIENCE PROGRAM SHOULD DEVELOP IN STUDENTS THE BASIC PROCESSES AND SKILLS OF SCIENCE

Learning Outcome

1. During the Elementary Science Program the student should understand and demonstrate the processes of:

   a. observing - the perception of similarities, differences and changes by using the senses.
      e.g. the student, using a mirror, will distinguish sameness and differences

   b. classifying - the organization of materials, events and phenomena into logical groupings. In its beginning stages classifying is a sorting process.
      e.g. the student will sort a given set of blocks into subsets based on common characteristics

   c. quantifying - the comparison of objects or events to agreed upon standards of length, areas, volume, mass, temperature, force, and time.
      e.g. the student will measure each day's growth of sprouting seeds

   d. communicating - the presentation of objects or events through various media in such a manner as to allow for their understanding by others. Much scientific communication is diagrammatic, numerical or graphic in form.
      e.g. the student will explain similarities and differences between seeds and seed-like materials

   e. interpreting data - the identification of trends from data. It is the perceiving of these trends which allows for inferring and predicting to occur.
      e.g. after constructing a graph of the lengths of the various thicknesses of water columns before they bead, the student will suggest that thinner columns bead sooner than thicker columns

f. inferring - the interpretation of data or observations and the perception of trends. These lead toward conclusions.
   e.g. given mixtures of white substances and using data previously collected concerning powder characteristics, the student will suggest the identity of the powders forming the mixture

g. formulating hypotheses - the formulation of generalized statements from observing or inferring. Further investigation is then required.
   e.g. after collecting data on temperature variations at different heights in the classroom, the student will state that temperature is greater at increased height

h. predicting - the use of existing data and information to suggest future outcomes or occurrences
   e.g. given a number of golf tees set on end within the orbit of a pendulum's swing, the student will predict which will be the last to be knocked down

i. controlling variables - the identification of possible variables influencing the outcome of an experiment or investigation. Those variables not being tested are held constant
   e.g. the student will investigate the effect of planting depth on seed germination by maintaining uniformity of all other conditions

j. experimenting - the testing of predictions and hypotheses by developing appropriate procedures. A scientific investigation and a reporting of the results should follow.
   e.g. in order to investigate one of the mealworm's senses, the student will design and carry out a test to determine if a mealworm has a sense of smell

k. defining operationally - the definition or identification in precise terms of an object or event so that others can duplicate the situation or result.
e.g the student will describe the procedures, outcomes, and results after completing an experiment on the behavior of rusting steel wool in a confined are

l. formulating model - the creation of analogies to demonstrate or explain an understanding. Models might take the form of concrete or abstract representation.
e.g. after constructing a functioning electrical circuit, the student will make a diagram using appropriate electrical symbols illustrating the circuit

Learning Outcome

2. During the Elementary Science Program the student should understand and demonstrate the skills of:

a. using appropriate tools and apparatus

b. locating, organizing, evaluating and reporting information

c. selecting and using appropriate methods to solve problems

GOAL C — THE ELEMENTARY SCIENCE PROGRAM SHOULD DEVELOP IN STUDENTS, SCIENTIFIC KNOWLEDGE

Learning Outcome

1. During the Elementary Science Program the student should demonstrate knowledge of:

   a. facts, generalizations, concepts, principles and laws

   b. scientific vocabulary

   c. the inter-relationship of the various disciplines of science

   d. the inter-relationship of science with other areas of human experiences

   e. the transitory nature of scientific "truths"

   f. the history of science as a developing body of knowledge

An outline of unit topics for each program is provided on pages 10 to 21. In addition, objectives and intended learning outcomes are stated in teacher guidebooks for each program.

## V. DESCRIPTION OF PROGRAMS

A. Materials Based Units
(ESS, EYE, Macdonald Educational)

B. Space - Time - Energy - Matter (STEM)

C. Exploring Science

## THE PROGRAMS

The revision provides three programs. The goals and learning outcomes of elementary science may be met through the selection of one of the program choices or through the use of any combination of the programs.

PROGRAM A - Materials Based Units Program

(Manual available from Publication Services)

As with the materials based program introduced in 1969, the kits and materials which are basic to this program must be purchased at the district and/or school level. Certain print materials, however, have been identified to support this program and these will be placed on the Prescribed Textbook List and will be provided by the Ministry.

PROGRAM B - STEM Science Program (Addison-Wesley)

This is a textbook program. The program components which will be provided by the Ministry will appear in the Prescribed Textbook List.

PROGRAM C - Exploring Science Program - Laidlaw (Doubleday)

This is a textbook program. The program components which will be provided by the Ministry will appear in the Prescribed Textbook List.

More specific information about each of the three programs follows. To provide additional assistance for teachers who wish to use this materials based program, the Ministry has also produced a publication Materials Based Units Program. This publication has been prepared in interim form for 1977-78.

## PROGRAM A

### Materials Based Units Program

This program, which is an extensive modification of the 1969 permissive elementary science program, consists of teachers' guides, kits and materials, and some student print material selected basically from four sources: Elementary Science Study, Examining Your Environment, Science 5/13 and Teaching Primary Science. It is a materials based program which necessitates the involvement of students in scientific activities and explorations.

#### Scope and Sequence

Process - Scope and sequence charts are provided for the processes. The charts list both the major and supporting processes for each unit. Teachers should select units which will ensure continuing and expanding pupil development in the process areas.

Content - Within the program a balance has been maintained between the biological and physical sciences. Teachers should select units which will ensure the continuing and expanding pupil development in both content areas.

#### Learning Outcomes

On the description page for each unit the major processes are listed as well as the intended content learning outcomes.

#### Manuals and Support Material

To support the series from which units have been selected, the following reference material should be consulted:

Elementary Science Study - McGraw-Hill

"An Introduction to E.S.S." McGraw-Hill, Newton, Mass., 1966. The philosophy of the E.S.S. approach to science education is explained.

"The McGraw-Hill Evaluation Program for E.S.S." McGraw-Hill, Montreal, 1974. Evaluation criteria in terms of observable behaviors are listed to assist in evaluating the student's performance. A teacher's guide is provided for each unit.

Examining Your Environment - Holt, Rhinehart & Winston

"Examining Your Environment, An Introduction for Teachers", Holt, Rhinehart and Winston, Toronto, 1974. This guide provides detailed information as to how to initiate the program, evaluate pupil progress and integrate the activities in this series. A specific teacher's guide for each unit as well as a sample students' manual is included.

Science 5/13 - Macdonald Educational - General Learning Corp.

The teacher's guide for each unit has been divided into three parts: one pertains to the first two Piagetian stages, another with the third stage. The final part offers teacher background information.

Teaching Primary Science - Macdonald Educational - General Learning Corp.

This is an extension of the Macdonald Series. The teacher's guide for each unit provides information concerning getting started, apparatus and organization and detailed guidance for development of learning activities.

For additional assistance specific teacher reference books are listed on the description page of most units.

To provide the pupils with the opportunity to increase their knowledge and to practice research and reporting skills, a list of student references is provided. This list is intended as a guide for school librarians and teachers when purchasing books to support the elementary science program.

Equipment

Information concerning equipment needs is provided on the description page of each unit.

For some units, prepackaged kits and/or print materials are available. Where no kit is available, an equipment list is provided to assist the teacher in organizing the unit. The list identifies only those items that under normal conditions may not already be available in the classroom or school.

For those units where a list has not been provided, under normal conditions the necessary equipment is easily obtainable.

In organizing a unit for study, especially those where a prepackaged kit is not available, the teacher should study the teacher's guide to determine the total equipment requirements.

## Program Outline

### BIOLOGICAL

#### Animal Life

| | |
|---|---|
| Year 1 | Animals in the Classroom (ESS) |
| Year 2 | Brine Shrimp (ESS) |
| Year 3 | Pond Water (ESS) |
| | Ourselves (Science 5/13) |
| Year 4 | Earthworms (ESS) |
| | Eggs and Tadpoles (ESS) |
| | Tracks (ESS) |
| Year 5 | Behavior of Mealworms (ESS) |
| | Mosquitos (ESS) |
| Year 6 | Small Things (ESS) |
| | Your Senses (EYE) |
| Year 7 | Birds (EYE) |
| | Small Creatures (EYE) |

#### Plant Life

| | |
|---|---|
| Year 1 | Growing Seeds (ESS) |
| | Early Explorations (Science 5/13) |
| Year 2 | Life of Beans and Peas (ESS) |
| Year 3 | Seeds and Seedlings (TPS) |
| Year 4 | Starting from Seeds (ESS) |
| Year 5 | Budding Twigs (ESS) |
| Year 6 | Trees (EYE) |
| Year 7 | The Dandelion (EYE) |

### PHYSICAL

| | |
|---|---|
| Year 1 | Geo Blocks (ESS) |
| | Lights and Shadows (ESS) |
| | Match and Measure (ESS) |
| | Science from Water Play (TPS) |
| Year 2 | Early Experiences (Science 5/13) |
| | Paints and Materials (TPS) |
| | Primary Balancing (ESS) |
| Year 3 | Candles (TPS) |
| | Changes (ESS) |
| | Ice Cubes (ESS) |
| Year 4 | Fibres and Fabrics (TPS) |
| | Mirrors and Magnifiers (TPS) |
| | Mobiles (ESS) |
| | Mystery Powders (ESS) |

| | |
|---|---|
| Year 5 | Coloured Solutions (ESS)<br>Mini-Climates (EYE)<br>Pendulums (ESS)<br>Rocks & Charts (ESS)<br>Structures (ESS) |
| Year 6 | Astronomy (EYE)<br>Batteries and Bulbs (ESS)<br>Mapping Small Places (EYE)<br>Peas and Particles (ESS) |
| Year 7 | Gases and Airs (ESS)<br>Kitchen Physics (ESS)<br>Musical Instruments (TPS)<br>Pinhole Photography (B.C.T.F. Lesson Aid) |

## PROGRAM B

### STEM Science - Addison Wesley

The STEM Science Program presents science education in a manner where both process and content are interrelated.

Four major themes, SPACE, TIME, ENERGY, and MATTER serve to group and relate science concepts in this program. At the primary level, concepts and processes are directly related to these four themes. Later the themes become increasingly interrelated and form connecting links in a scope of content that includes: matter, human biology, heat and temperature, weather, space, light, sound, electricity, and magnetism in addition to other areas of study.

Content and process are both important in this program. Throughout the program, however, the development of the various processes is of an ongoing and repetitive nature which suggests a process-activity orientation.

At every level the program provides basic material suitable for most children at that level. Often this basic material is expansive enough to include the majority of, as well as the exceptional, student. Throughout the program, fundamental concepts are repeated in somewhat different forms. This serves both to reinforce these concepts and to provide a necessary base for new pupils who enter the program with little previous background in science. Throughout, the student is encouraged to engage in first-hand experiences in both individual and groups settings.

The teacher's editions consist of full-colour reproductions of each page from the student's text. Essentially five supportive elements are provided for each lesson in the teacher's edition:

- a statement of the scientific ideas in the lesson
- intended learning outcomes
- ideas on presenting the lesson
- suggestions concerning evaluation
- extension and enrichment opportunities

The teacher's edition provides information for the teacher which facilitates the effective use of all components of the program.

Main Program Components:

a. student texts
b. student activity record books: years 3-7
c. teacher's edition
d. stated behavioral objectives
e. suggestions for evaluation
f. recommended equipment for "hands-on" activities
g. evaluation program (ditto master tests) levels 3-6

Program Outline

| | |
|---|---|
| Year 1 | Animals |
| | Plants |
| | Distance |
| | Occupying Space |
| | Order |
| | Shorter Times |
| | Longer Times |
| | Moving Things |
| | Solids |
| | Water |
| | Air |
| | Soil |
| | Where |
| Year 2 | Seeds |
| | Animals in Autumn |
| | Standards |
| | What is Time? |
| | Measuring Time |
| | What Moves the Mover? |
| | Kinds of Matter |
| | Bits |
| | Small vs Large |
| | Changes in Matter |
| | Plants in Spring |
| | Animals in Spring |
| | Doing Your Part |
| Year 3 | Measurement |
| | Motions and Location |
| | Measuring Time |
| | Shadows and Light |
| | Sunlight on Earth and Moon |
| | Air and Air Pressure |
| | Heat and Temperature |
| | Communities and Living Things |
| | It All Depends! Helpful or Harmful |
| Year 4 | Water and the Land |
| | The Food You Eat |
| | Electric Light Circuits |
| | Cells, Tissues, and Your Body |
| | Friction-Rubbing and Rolling |
| | Your Body's Needs |
| | Stars - Night and Day |
| | Vibrations and Sound |
| | Heat |

| | | |
|---|---|---|
| | Year 5 | Paths of Light |
| | | Classifying Living Things |
| | | Magnets and Compasses |
| | | Winds and Convection |
| | | Rocks in Layers |
| | | Forces and Motions |
| | | Changes in Matter |
| | | Man on the Moon |
| | | Interdependence of Living Things |
| | Year 6 | Images, Refraction, and Colour |
| | | Water in the Air |
| | | The Earth and Its Neighbours |
| | | Using Forces |
| | | Electric Charges and Currents |
| | | Living Things - Continuity and Change |
| | | Changes in the Land |
| | | Populations |
| | | Changing and Preserving our Environment |
| * | Year 7 | The Interaction of Organisms and the Environment |
| | | The Environment |
| | | Solar Energy |
| | | Climate and Biomes |
| | | Ecosystems in Water |
| | | Ancient Ecosystems |
| | | From Generation to Generation |
| | | The Internal Environment |
| | | It's Your Decision |
| | | Soil, A Product of the Environment |
| | | Earth, The Water Planet |
| | | Imbalance in the Ecosystem |
| | | Land Management Within Limits |

* (Unavailable in 1977-78)

## PROGRAM C

### Exploring Science - Doubleday Canada

The Exploring Science Program has been designed to provide students with learning experiences in both the knowledge and processes of science.

The entire program is based upon science concepts that cluster around forty-five unit topics, six for each learning level 1-6 (nine at level 7). The program integrates the skills and concepts of the biological sciences, physical sciences, and earth-space sciences. At each level (1-6), two units are devoted to each of these three areas, at year seven there are 3 units per area.

The content in the program enables students to study the major areas of science every year. As students grow and mature from year to year, the content changes accordingly, taking into account the students' abilities, understandings, experiences, interests, and reading level.

In addition, concepts and activities are tied whenever possible to other curriculum areas. At the primary levels, experiences usually enhance language, number, art, and reading development. At higher levels, these tie-ins occur with social studies, health and safety, valuing, reference skills, career awareness and so on.

The program provides opportunities for students to develop skill in using the processes of science.

The teacher's edition consists of full-colour reproductions of each page from the students' text with extended bottom margins followed by a twelve page teacher's manual. The inclusion of the students' pages makes it possible to easily point out something on the page for the pupils. The extended bottom margins make it possible to have a variety of specific teaching helps immediately available on the lesson page. The teacher's manual contains information to help the teacher understand and use all the components of the program effectively.

Main Program Components:

a. student texts: (single texts for years 1-6, year 7 consists of three modules)
b. correlated activity books: Years 4-7
c. teacher's edition including manual
d. stated performance objectives
e. suggestions for evaluation
f. recommended equipment for "hands-on" activities
g. unit tests and answer key in teacher's manual

Program Outline

BIOLOGICAL SCIENCES

| | |
|---|---|
| Year 1 | Your Senses<br>Living Things |
| Year 2 | Food for Animals and You<br>Environment |
| Year 3 | Seed Plants<br>Animal Behavior |
| Year 4 | Plant Growth and Behavior<br>Animals and Their Environment |
| Year 5 | Small Living Things<br>Your Body |
| Year 6 | Interacting with Your Environment<br>Plant and Animal Life Cycles |
| Year 7 | Ecology: Interaction in the Environment<br>Biology: The Study of Living Things<br>The Human Body: The Study of Yourself |

PHYSICAL SCIENCES

| | |
|---|---|
| Year 1 | Sorting<br>Light and Shadows |
| Year 2 | Measuring<br>Magnets |
| Year 3 | Heat and Temperature<br>Sounds Around You |
| Year 4 | Work and Machines<br>Solids, Liquids, and Gases |
| Year 5 | Electricity on the Move<br>Light |
| Year 6 | Matter and You<br>Changes in Energy<br>Science: Something People Do |
| Year 7 | Energy for Work and Motion<br>Technology: Using Science |

EARTH-SPACE SCIENCES

| | |
|---|---|
| Year 1 | Time<br>Spaces and Places |
| Year 2 | The Moon<br>Rocks and Soil |
| Year 3 | Water in Your Environment<br>Location, Motion, and Force |

| | |
|---|---|
| Year 4 | Air and Weather<br>Watching the Sky |
| Year 5 | The Changing Land<br>Mapping the Earth |
| Year 6 | The Earth in Space<br>Ecosystem Earth |
| Year 7 | Earth: Its Nature and Importance to You<br>Water: More than a Resource<br>Air: The Changing Atmosphere |

## VI. EVALUATION

Evaluation determines the extent to which the learning outcomes have been achieved. In addition it should serve to improve educational decision making and to redirect learning. Data from subjective and objective tests, self-evaluation, interviews, and checklists based on informal observations of student performance can facilitate more effective teaching and learning.

Some examples of how evaluation might be used include:

1. Determining student knowledge, skills, attitudes at the BEGINNING of a unit. This will enable the instructional program to be tailored to both the needs of the individual and those of the group.

2. ONGOING evaluation during a unit enables students to assess their progress and teachers to diagnose weaknesses and alter methods and materials accordingly.

3. Evaluation at the CONCLUSION of a unit enables the teacher to ascertain the degree to which outcomes have been achieved and to make judgements on the overall effectiveness of the instructional program.

Of primary importance to the teacher of science is a clear understanding of what is to be evaluated. To be effective, evaluation should correspond to specific objectives selected prior to beginning instruction. Evaluation can focus on the various aspects of science and learning; the recall of facts or knowledge, the use of processes, the internalization of criteria, reference should continually be made to evaluate criteria developed by the group.

Inherent in the approach to science instruction is the recognition on the part of the teacher that teaching and learning can involve the participants in experiences which need not be evaluated - experiences involving children learning to learn.

Three audiences receive direct benefit from evaluation; students receive concrete information about their progress, teachers are able to plan and redirect programs based on factual information, and parents receive a clear statement of what students are learning.

Evaluation misused can be destructive. Evaluation overused can interfere with the process it is designed to assist. Evaluation not used, however, denies teacher, student and parent valuable information on progress being made.

## VII. RESEARCH AND REPORTING SKILLS

The elementary science program stresses the importance of a balance between process and content in science education. The curriculum guide states that expository instruction is one method whereby content can be transmitted. The program also states in its goals and learning outcomes that; during the Elementary Science Program, the student should:

- demonstrate the self-confidence to initiate investigations
- demonstrate the attitude of curiosity - to question and seek answers in the various areas of science
- understand and demonstrate the skills of locating, organizing,evaluating and reporting information
- acquire scientific knowledge

These goals cannot all be realized through teacher centered instruction. The accumulated body of scientific knowledge is too vast for the teacher to impart. Students should be trained to find and use information for themselves. It is suggested, that in order to achieve this objective, a sequential research skills program should be developed and initiated in each elementary school.

Such programs are most effective when they are developed locally. Each school has its unique needs and resources; these will be reflected in the research program. Many schools have developed successful programs through the cooperative efforts of the librarian and staff. It has been found that in the process of program development a greater understanding of the responsibilities and strengths of the librarian and teachers become apparent to all. Once a staff has undertaken a task of this nature, they feel a greater commitment to make the program a success.

Elementary school libraries contain a wide range of media resources for student use. Students should be trained to make full use of these resources, which might include:

| | | |
|---|---|---|
| almanacs | encyclopedias | models |
| atlases | films | pamphlets |
| biographies | film strips | periodicals |
| books | globes | slides |
| community resources | graphs | telephone books |
| dictionaries | magazines | |

The role of the librarian is to develop with the teachers a sequential media research program, to advise the teachers of the material available, to join teachers in planning and organizing lessons and teaching strategies to achieve the level of competence expected in the students, to maintain an efficiently operated library, to help and advise the teachers in the preparation of report assignments and to aid the students working on library assignments.

It is the responsibility of teachers to be involved in the development of the media research program, to instruct the students in the skills decided upon for their grade level, to review and refine the skills taught in previous years, and to teach as many of these skills as possible as an extension of the learning situation in the classroom. Media research skills which are taught out of context with the regular program are not as effective as they could be. When it is impossible to relate the skills to the classroom situation, the librarian should be consulted for assistance.

The research skills program lends itself to individualization; each student progressing to the next step when the previous skill has been mastered. It is also relatively simple to devise independent as well as group assignments. In addition, it is possible to design a research topic which covers a wide range and then offer the students a choice of topic they wish to cover.

Teachers at times may be disappointed in the quality of reports prepared by students. The following is a list of suggestions which may be helpful.

1. Be sure the pupils have been taught the skills required to:
   a. find information
   b. discriminate between relevant and irrelevant material
   c. arrange the information in a logical manner
   d. rewrite the information in their own words
   e. use maps and diagrams to illustrate a point they wish to make
   f. prepare a bibliography
2. Having decided on a topic, check with the librarian to see that there is enough material on hand and ask for suggestions or alternate topics, and make explicit the skills being taught.
3. Be specific in giving directions. Most students in the elementary grades require a clear idea of the teacher's expectations. Each pupil and the librarian should be given a copy of the assignment which should include the following:
   a. the date the assignment is due
   b. the approximate length
   c. some aspects of the topic which should be included
   d. whether or not a bibliography is required
   e. whether or not rough notes should be submitted (until the students are adept at note-taking it has

been found that asking for rough notes reduces copying, since each point in the report must have originated from the rough notes)

f. how the report will be evaluated

4. Vary the manner in which the report will be presented, e.g. oral, written, tape-recorded, video-taped, models and displays.

## VIII. BASIC EQUIPMENT & MATERIALS LIST

The following is suggested as a basic list of equipment which should be found in every elementary school. Extension of this supply list will depend upon the program chosen. Quantities, sizes, and make of items are left to the discretion of purchasers.

Aquarium, plastic with cover and island

Aquarium, 10-gal. glass, pump, aerator, etc.

Alchohol, (methyl hydrate)

Aluminum foil

Bags, polyethylene, assorted sizes

Balances, equal arm

Balances, pegboard beam, two-pan

Ball and ring set

Balloons, assorted

Balsa wood

Barometer, aneroid

Beakers, plastic and pyrex

Bran

Brushes, cleaning

Brush, wire

Burners, alchohol

Bulbs, flashlight, assorted

Cages, animal

Cans, tins, assorted sizes

Candles, birthday and standard

Cheesecloth

Clothespins

Compasses

Corks

Cotton, absorbent

Cover slips, plastic and pyrex

Food colors

Forceps

Formaldehyde

Funnels, glass and plastic

Gloves, rubber
Glue, epoxy and plastic
Glycerine
Goggles, safety
Holders, battery and bulb
Hooks, cup
Hot-plate, electric
Iodine, tincture
Iron filings
Jars, assorted
Labels
Lens set - light experiments
Lens, Magnifiers
Lens paper
Lightmeter, foot-candle
Magnets
Matches
Measuring tape
Metal sticks and trundle wheels
Microscopes, simple
Mirrors
Mortar and pestle
Nails, assorted
Oil - cooking and mineral
Pails, plastic
Pans, aluminum foil, assorted
Paper clips
Paper fasteners
Paper, waxed
Paraffin wax
Petri-dishes, plastic
Pins, straight
Pipe cleaners
Plastic - Saran Wrap
Plaster of Paris

Plasticene
Plates, paper
Prisms
Protractors
Pulleys, assorted
Ring stands
Rubber bands
Rubber sheeting
Rubber stoppers
Salt
Sandpaper
Scalpels
Screw-eyes
Screws, assorted
Seeds, assortment
Shovel
Sieves - varied mesh
Slides, microscope
Sodium bicarbonate (baking soda)
Soil, potting
Sponges
Spoons, plastic
Stain, Eosin-Y and Methylene blue
Stands, test-tube support
Steel wool
Stir sticks
Straw - plastic and paper
String
Sugar
Syringes
Tape - cellulose and masking
Test tubes - assorted
Thermometers
Thread
Thumbtacks

Tools, triangular files. claw hammer, knives, pliers, saw, screwdriver, tin snips, wire cutter and stripper, wrench

Toothpicks

Trays - pulpboard, assorted sizes

Trays, tote

Trowels

Tubing, plastic

Vials, with caps

Vinegar

Washers, variety of sizes and metals

Weights, lead fishing

Weights, metric set

Wire, electrical, bare and insulated